where,

$R^{III}_{50/52}$	is the measured isotope of ^{50}Cr to ^{52}Cr of Cr(III) in the spiked sample
$R^{III}_{53/52}$	is the measured isotope ratio of ^{53}Cr to ^{52}Cr of Cr(III) in the spiked sample
$R^{VI}_{50/52}$	is the measured isotope ratio of ^{50}Cr to ^{52}Cr of Cr(VI) in the spiked sample
$R^{VI}_{53/52}$	is the measured isotope ratio of ^{53}Cr to ^{52}Cr of Cr(VI) in the spiked sample
$^{50}A_x$	is the natural atomic fraction of ^{50}Cr in the sample
C_x^{III}	is the concentration of Cr(III) in the sample (μmole/g, unknown)
W_x	is the weight of the sample in grams
$^{50}A_s^{III}$	is the atomic fraction of ^{50}Cr in the isotopic spike: ^{50}Cr(III)
C_s^{III}	is the concentration of Cr(III) in the ^{50}Cr(III) spike (μmole/g)
W_s^{III}	is the weight of the ^{50}Cr(III) spike in grams
C_x^{VI}	is the concentration of Cr(VI) in the sample (μmole/g, unknown)
α	is the percentage of Cr(III) oxidized to Cr(VI) after spiking (unknown)
ß	is the percentage of Cr(VI) reduced to Cr(III) after spiking (unknown)

REMARKS

The Office Action dated July 6, 1999 has been reviewed carefully and the application amended in a sincere effort to place the same in condition for allowance. Reconsideration of the original rejections and allowance of the amended claims are respectfully requested on the basis of the following remarks.

The Invention

The present invention has solved a number of problems in respect of existing procedures for isotope dilution mass spectrometry through the creation of speciated isotope dilution mass spectrometry which has capabilities above and beyond the existing state of the art in the former. The present invention provides for mathematical deconvolution of the species concentration while correcting for species conversion and incomplete separation of the species from the sample. It also provides for species by species determination of concentration and for the creation of standards for use in such determinations.

These features among others are discussed throughout the specification including the extensive examples which contain comparative data and confirmation of the

operability of applicant's invention. See the examples beginning at the top of page 17 through page 45, line 10.

Table II, which appears at the top of page 31 and the discussion regarding the same which begins at line 21 on page 31, provides an analysis of the successful performance of the SIDMS (speciated isotope dilution mass spectrometry) of the present invention along with a comparison contained in the last two columns of conventional isotope dilution mass spectrometry. Columns 9 and 10 of Table II, which columns bear the heading "Conventional IDMS" lists the results of using the IDMS approach contained in column 2 with resultant systemic errors as contrasted with the ability to correct for species conversion in addition to improving the precision and detection limits of the presently claimed invention.

Amended claim 1, which is the sole independent claim in the application, clearly recites these distinguishing characteristics of the invention. More specifically, it is directed toward a method of speciated isotope dilution measurement of a sample which includes providing at least one predetermined stable isotope and preparing a different isotopic spike for each species to be measured by converting each stable isotope to a speciated enriched isotope corresponding to the species to be measured in the sample. The sample containing the species to be measured is spiked and equilibrating of the isotope-spiked species with the species to be measured is then performed followed by separation of at least a portion of the species from the sample. Isotope ratio determinations are made for each specie to be measured and mathematically deconvoluting the species concentration while correcting for species conversion and effecting mathematical deconvolution while correcting for incomplete separation of the species from the sample. As will be discussed hereinafter, the dependent claims further refine the method.

Claims 1-33 – Section 112

The Examiner's reference to the use of a different isotope enriched spike as found at page 22, line 19 through page 23, line 3 of the specification as contrasted with the prior art use of the same isotope enriched material and the use of the IDMS equation has been noted and appropriate amendments which have been described herein have been made to claim 1. It is respectfully submitted that this objection has been obviated.

Claim 4 – Section 112

The Examiner's alertness in noting the presence of the single symbol identification and the need for the additional three corresponding identifications has been appreciated and appropriate amendments have been made.

It is respectfully submitted that the Section 112 objection to claim 4 has been obviated.

Claims 1-3, 5-33 – Section 102(b)

These claims have been rejected on the basis of the present inventor's U.S. Patent 5,414,259. This patent is directed toward the use of isotope dilution mass spectrometry and provides a number of beneficial features as set forth by the Examiner.

There is no teaching or suggestion in the cited reference of a number of the recited features of claim 1 as amended. This includes the ability to employ a different isotopic spike for each species to be measured with subsequent mathematical deconvoluting of the species concentration while correcting for species conversion and incomplete separation of the species from the sample. Dependent claim 2 recites employing the method on more than one species simultaneously and dependent claim 3 recites quanitification of Cr(III) and Cr(VI).

The feature of claim 5 is claimed solely in the context of amended claim 1 from which it depends.

Claim 6 recites tagging the enriched isotope with an isotopic tag in the same speciated form as the species to be measured and claim 7 recites employing time resolution chromatography to effect said separation.

Dependent claim 8 recites employing the process on a sample which has experienced specie conversion prior to separation. Claim 9 recites effecting equilibrium in an aqueous solution.

Dependent claim 10 expressly recites employing the process on an incompletely separated specie. This formed no part of the original cited patent and is supported by data contained in Figures 9(a) and 9(b). This portion of the method facilitates accomplishing a precise and accurate result on what otherwise might be considered an inadequate specimen.

Dependent claim 11, which depends from claim 3, recites effecting the separation after reduction of a substantial portion of Cr(VI) to Cr(III). Claim 12 recites employing the method on a soil sample and claim 13 recites employing it on an aqueous

sample. Claim 14 recites employing the process on solid waste from a chromite ore processing system. Solid samples present a different dimension of problem.

Claim 15 expressly recites storing the sample after the equilibrating step and prior to the separation step.

Dependent claim 16 recites effecting mathematical deconvoluting simultaneously with respect to more than one species to be measured. Claim 17, which depends from claim 16, recites effecting the mathematical deconvolution for each species independently of the other species.

Claim 18 depends from claim 1 and recites deconvoluting with respect to only one species to be measured.

Claim 19 depends from claim 16 and recites effecting the separation of at least about 5 to 10 percent less than 100 percent of each species from the sample and from the other species before effecting deconvolution. There is no such teaching or suggestion in the cited reference.

Claim 20, which depends from claim 1, recites preferred methods of separation employed in the context of the method of claim 1.

Claim 21 recites effecting the separation by microwave assisted extraction for a period of about 5 to 15 minutes. There is no such teaching in the cited reference. The data supporting this is discussed in the specification with respect to the Figure 10.

Claim 22, which depends from claim 21, recites effecting the separation at about 90° C to 150° C. These preferred approaches were not part of the cited reference.

Dependent claim 3 recites the method employed for purposes of validating another type of test. This is not taught or suggested by the cited reference.

Claim 24, which depends from 23, recites effecting a plurality of measurements by the other tests and effecting the comparison in evaluating the validity of the other tests.

Claim 25 recites the use of the method in preparing speciated spiked standard materials. This forms no part of what is taught or suggested by the Kingston reference. Claim 26 depends from claim 1 and recites employing the method to prepare standard materials.

Claim 27, which depends from claim 25, recites the creation of the new standards spiked with isotopically enriched species in different forms.

Claim 28, which depends from claim 26, recites employing the standard materials after storage. The cited reference did not deal with such concepts.

Claim 29, which depends from claim 26, recites employing the method to correct species shifts in the standard material after degradation.

Claim 30, which depends from claim 21, recites employing in the microwave extraction closed vessel microwave extraction.

Dependent claim 31, which depends from claim 33, recites the contribution of the method validating tests which are "not independently capable of compensating for incomplete species extraction or species conversion." The specification discussion regarding Figures 9(a) and 9(b) is related to this feature.

Dependent claim 32 recites performing the method on a species which due to incomplete separation, loss, conversion, or degradation has less the 100 percent of this species separated. This ability to accomplish the objective of speciated isotope dilution measurement on an incomplete specimen is not taught or suggested by the reference.

Finally, dependent claim 33 depends from claim 32 and recites effecting the separation of at least about 5-10 percent of the species. This recites the fact that the invention will work successfully even with such a relatively small portion of the sample.

In summary, it is respectfully submitted that Kingston U.S. Patent 5,414,259 made substantial advancements over the then existing prior art, but does not teach or suggest the features of the foregoing claims and it is respectfully submitted that claims 1-3 and 5-33 are patentable thereover.

Claim 4 – Section 103(a)

This claim has been amended as being unpatentable over Kingston as previously applied in further view of the newly cited and applied Moore reference.

The comments made hereinbefore with respect to Kingston are equally applicable at this juncture.

Applicant in claim 4, which depends indirectly from amended claim 1, recites the method employing the preferred mathematical deconvolution involving the four preferred mathematical relationships is distinct from the teaching of the relationship set forth in column 8 of Kingston 5,414,259 and the Moore paper which is directed toward a totally different objective. Moore would teach one skilled in the art to focus on thermal fractionation wherein the isotopes are heated on an inert filament in a vacuum in a mass spectrometer and the lighter ones come off first in some cases and shift true or bulk composition isotope ratio. Moore is proposing to assist with this mass spectrometer correction. The thermal fractionation is totally distinct from speciation as all of the isotopes are in the same chemical forms in a homogeneous solution and do not transform one to another as isotopes are permanent fundamental masses. Moore is merely

correcting the ratio. No chemical forms may differ on an isotopic basis for Moore's work. In summary, Moore merely deals with thermal fractionation causing errors in isotope ratio measurements and his effort to correct the accuracy of isotope ratio measurements. This is distinct from applicant's correction for species transformations as described hereinbefore.

It is respectfully submitted that the combination of the cited Kingston reference and the Moore reference cannot be effected without substantial destruction of the individual teachings as there are different objectives, different problems, and different means of dealing with them. As was stated by the Court in the case of In re Imperato 179 USPQ 730 (CCPA 1973), a copy of which is enclosed for the convenience of the Examiner, at page 732:

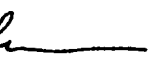
> With regard to the principal rejection, we agree that combining the teaching of Schaefer with that of Johnson or Amberg would give the beneficial result observed by appellant. However, the mere fact that those disclosures can be combined does not make the combination obvious unless the art also contains something to suggest the desirability of the combination.... We find no such suggestion in these references.

This guidance would appear to be fully applicable in the present context. It is respectfully submitted that the language is appropriately applied in the present context.

Summary and Conclusions

It is respectfully submitted, for reasons stated herein, that amended claims 1 and 4 obviate the Section 112 rejections and that claims 1-3 and 5-33 are patentable over the cited Kingston reference and that claim 4 is patentable over the combination of Kingston and Moore. As a result, it would appear that the application is now in proper form for issuance of a Notice of Allowance and such action is respectfully requested at an early date.

Respectfully submitted,



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